This document contains Part 1 (pp.163–171) of Chapter 6 of the National Coastal Condition Report III.

The entire report can be downloaded from http://www.epa.gov/nccr

National Coastal Condition Report III

Chapter 6: West Coast Coastal Condition

Part 1 of 3

December 2008

CHAPTER 6

West Coast Coastal Condition

Courtesy of Brad Ashbaugh

West Coast Coastal Condition

As shown in Figure 6-1, the overall condition of the coastal waters of the West Coast region is rated fair. The water quality index is rated fair; the sediment quality index is rated fair to poor; the benthic index is rated good; and the coastal habitat and fish tissue contaminants indices are rated poor. These ratings were primarily driven by NCA survey results for the Puget Sound and San Francisco Bay estuarine systems, which together represent a large percentage of the total coastal area of the West Coast region. The watersheds surrounding these two systems, together with coastal watersheds in southern California, also have the highest population densities in the West Coast region. In contrast, the majority of smaller estuarine systems along the West Coast were estimated to be in better condition. Figure 6-2 provides a summary of the percentage of coastal area in good, fair, poor, or missing categories for each index and component indicator. This assessment of West Coast coastal waters is based on environmental stressor and response data collected by NCA from 210 sites in 1999 and 171 sites in 2000 as part of a pilot project. Data on sediment contaminants for 41 of the 71 Puget Sound sites were collected by NOAA's NS&T Program in 1997–1999. NOAA NS&T also provided sediment and infauna data for 33 of the 50 sites in San Francisco Bay in 2000. Please refer to Chapter 1 for information about how these assessments were made, the criteria used to develop the rating for each index and component indicator, and limitations of the available data.

Although the majority of the data discussed in this chapter were also presented in the NCCR II (U.S. EPA, 2004a), this report presents slightly different rating results for the West Coast region. During the interval between the publication of the NCCR II and the NCCR III, benthic community data collected in 2000 from San Francisco Bay became available, and all benthic community data collected from coastal waters during 2000 (Puget Sound, Columbia River, San Francisco Bay) were included in this NCCR III assessment. As a result of the inclusion of these new data, the

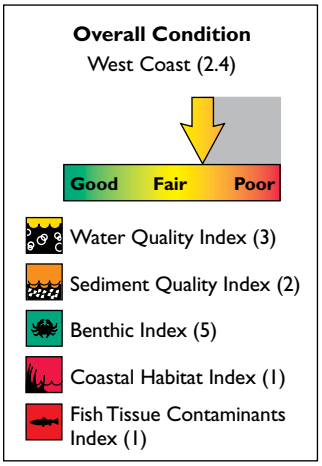


Figure 6-1. The overall condition of West Coast coastal waters is rated fair (U.S. EPA/NCA).

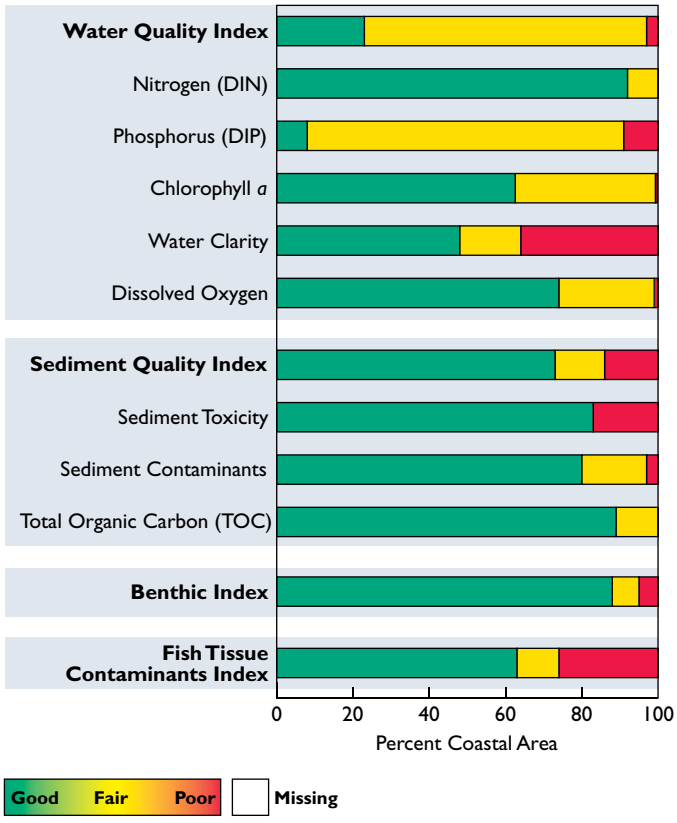


Figure 6-2. Percentage of coastal area achieving each ranking for all indices and component indicators—West Coast region (U.S. EPA/NCA).

The NCA monitoring data used in this assessment were based on single-day measurements collected at sites throughout the United States during a 9- to 12-week period in late summer. Data were not collected during other time periods.

overall condition rating for the coastal waters of the West Coast region changed from a rating of fair to poor, with an overall condition score of 2.2 (NCCR II), to the current rating of fair, with an overall condition score of 2.4. The benthic index rating for the region also changed from a rating of fair (NCCR II) to the current rating of good. In addition, water column means, rather than surface sample results, were inadvertently used in the NCCR II assessment of the DIN, DIP, and chlorophyll *a* data collected during 1999 and 2000. Although the reassessment of these data resulted in changes to the percent of coastal area rated good, fair, and poor for these component indicators and for the water quality index, the ratings for the water quality index and component indicators remain unchanged from those presented in the NCCR II. Data QC and refinement since the NCCR II also caused some slight differences in the percent area rated good, fair, or poor for the other indices and component indicators assessed in this report.

The West Coast coastal area comprises more than 410 estuaries and bays, including the sub-estuary systems that are associated with larger estuaries. The size range of these West Coast coastal waterbodies is illustrated by five order-of-magnitude size classes of the systems sampled by EMAP/NCA—from 0.0237 mi^2 (Yachats River, OR) to 2,551 mi^2 (Puget Sound and the Strait of Juan de Fuca, WA). The total coastal area of the West Coast estuaries, bays, and sub-estuaries is 3,940 mi^2, 61.5% of which consists of three large estuarine systems—the San Francisco Estuary, Columbia River, and Puget Sound (including the Strait of Juan de Fuca). Sub-estuary systems associated with these large systems make up another 26.8% of the West Coast coastal area. The remaining West Coast coastal waterbodies combined comprise only 11.7% of the total coastal area of the West Coast region.

West Coast coastal waters are located in two provinces: the Columbian Province and the Californian Province. The Columbian Province extends from the Washington–Canada border south to Point Conception, CA. Within the United States, the Californian Province extends from Point Conception south to the Mexican border. There are major transitions in the distribution of human population along the West Coast, with increased population density occurring in the Seattle–Tacoma area of Puget Sound, around San Francisco Bay, and generally around most of the coastal waters of southern California. In contrast, the section of coastline north of the San Francisco Bay through northern Puget Sound has a much lower population density.

The coastal waters of the West Coast region represent a valuable resource that contributes to local economies and enhances the quality of life for those who work in, live in, and visit these areas. In the West Coast states of California, Oregon, and Washington, the majority of the population lives in coastal counties. The coastal population of the West Coast region increased 47% between 1980 and 2003 to a total of 37.5 million (Figure 6-3), and 2003–2008 population growth rates for the counties bordering the San Diego, San Francisco, and Puget Sound estuaries are projected to be more than 40% (Crossett et al., 2004). These growth rates suggest that human pressures on West Coast coastal resources will increase substantially in future years.

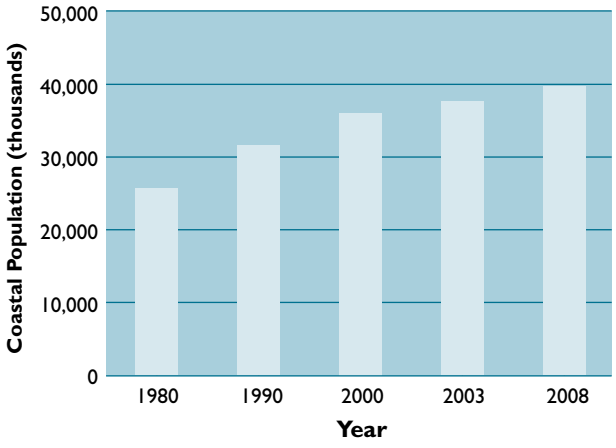


Figure 6-3. Actual and estimated population of coastal counties in West Coast states from 1980 to 2008 (Crossett et al., 2004).

The sampling conducted in the EPA NCA survey has been designed to estimate the percent of coastal area (nationally or in a region or state) in varying conditions, and the results are displayed as pie diagrams. Many of the figures in this report illustrate environmental measurements made at specific locations (colored dots on maps); however, these dots (color) represent the value of the indicator specifically at the time of sampling. Additional sampling would be required to define temporal variability and to confirm environmental condition at specific locations.

Coastal Monitoring Data—Status of Coastal Condition

Relatively few national programs monitor the coastal waters of the West Coast region. NOAA's Estuarine Eutrophication Survey (NOAA, 1998) examined a number of eutrophication variables for West Coast coastal waters through the use of a survey questionnaire. In addition, NOAA's NS&T Program collects data for several locations along the West Coast (Long et al., 2000), but these sites are not representative of all West Coast coastal waters. EMAP-like surveys have also been completed in the Southern California Bight (SCB) (SCCWRP, 1998). In comparison with these geographically focused studies, the NCA sampled small western estuaries in 1999 and 2001 (Oregon only), large estuaries in 2000, the intertidal areas of small and large estuaries in 2002, and the waters of the continental shelf in 2003. A reassessment of coastal condition along the West Coast was conducted in 2004 for the NCA. Unfortunately, most of these data are not yet available for use in this report; therefore, this section focuses only on the assessment of data collected in small and large West Coast coastal waterbodies from 1999 to 2000.

Water Quality Index

The water quality index for the coastal waters of the West Coast region is rated fair, with 74% of the coastal area rated fair and 3% rated poor for water quality condition (Figure 6-4). The water quality index was developed based on measurements of five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. The sites rated poor for water quality condition were found primarily in California. The only sampling site outside California with poor water quality was located in southern Hood Canal, WA. Low ratings for the water quality index were driven primarily by high DIP concentrations and poor water clarity.

Nutrients: Nitrogen and Phosphorus

The West Coast region is rated good for DIN concentrations, with 8% of the coastal area rated

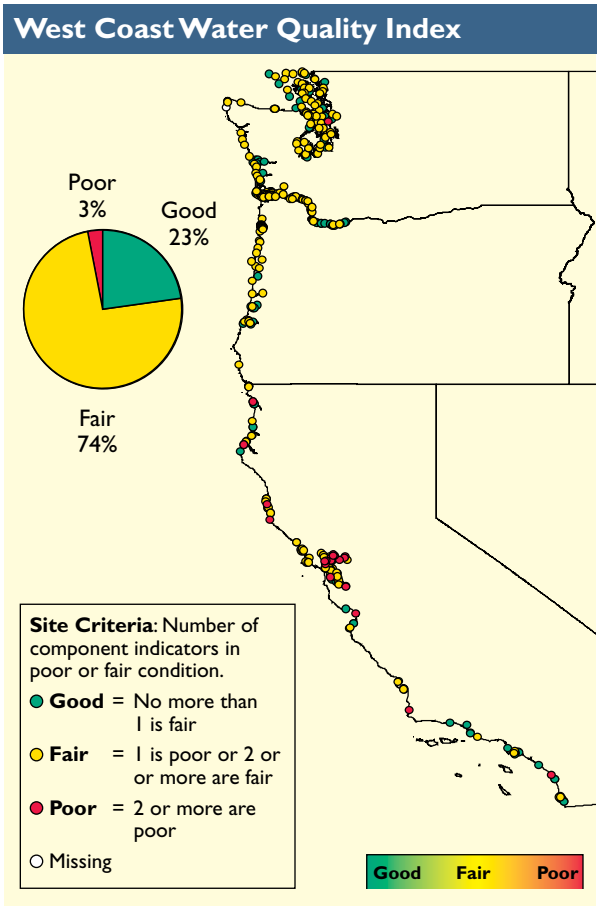


Figure 6-4. Water quality index data for West Coast coastal waters (U.S. EPA/NCA).

fair and less than 1% of the area rated poor for this component indicator. The West Coast region is rated fair for DIP concentrations, with 83% of the coastal area rated fair and 9% rated poor for this component indicator. Upwelling may be an important contributing factor to the DIN and DIP concentrations measured in the coastal waters of the West Coast region during the summer season.

Chlorophyll a

The West Coast region is rated good for chlorophyll *a* concentrations, with 37% of the coastal area rated fair for this component indicator. Less than 1% of the area was rated poor for chlorophyll *a* concentrations, with the sites rated poor located in California and Washington (southern Hood Canal).

Water Clarity

Water clarity is rated poor for the West Coast region, with 16% of the area rated fair and approximately 36% of the coastal area rated poor for this component indicator. The same criteria were used to assess water clarity across the region, with a sampling site receiving a rating of poor if less than 10% of surface illumination was measured at a depth of 1 meter. The results of the 2000–2001 NCA assessment are consistent with those made by the NOAA Estuarine Eutrophication Survey (NOAA, 1998), which reported high turbidity in 20 of the 38 West Coast estuaries surveyed.

Dissolved Oxygen

The West Coast region is rated good for dissolved oxygen concentrations, with 25% of the coastal area rated fair for this component indicator. Approximately 1% of the coastal area was rated poor for dissolved oxygen concentrations, with the sites rated poor located in some sub-estuaries of Puget Sound (Dabob Bay and southern Hood Canal). Puget Sound is a deeper, fjord-like system and may often have low dissolved oxygen concentrations in the bottom waters of its more restricted arms.

Sediment Quality Index

The sediment quality index for the coastal waters of the West Coast region is rated fair to poor, with 14% of the coastal area rated poor for sediment quality condition (Figure 6-5). The sediment quality index was developed based on measurements of three component indicators: sediment toxicity, sediment contaminants, and sediment TOC. Elevated metal concentrations at stations in San Francisco Bay and high metal and organic compound concentrations at stations in the harbors and bays of the Puget Sound system (e.g., Duwamish River, Commencement Bay) impacted the region's sediment quality index rating. Toxic sediments collected at sites within Puget Sound, the Columbia River, and Willapa Bay were the second-most important contributor to

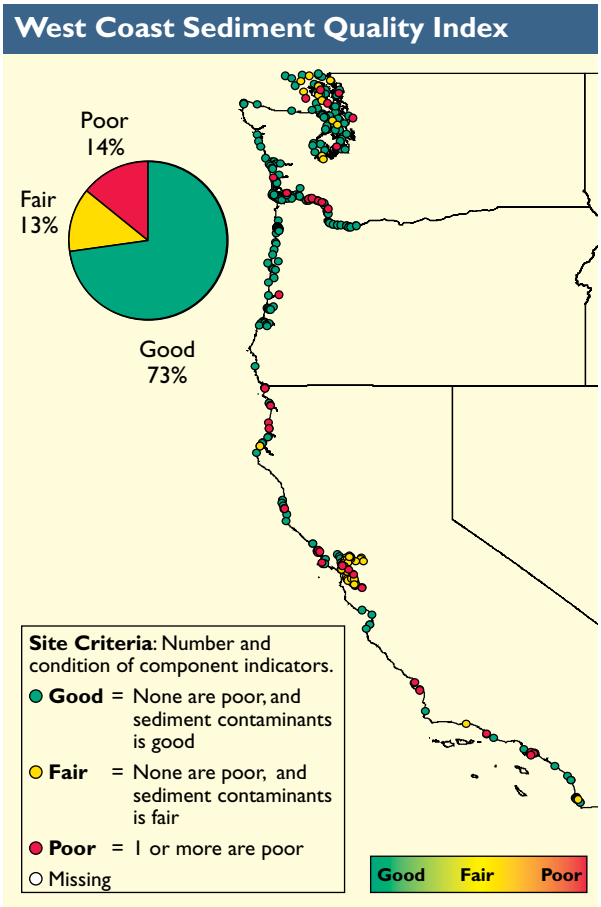


Figure 6-5. Sediment quality index data for West Coast coastal waters (U.S. EPA/NCA).

the areal estimate of poor condition for the West Coast region. In addition, sites in several other areas had either elevated sediment contaminant concentrations or high sediment toxicity (e.g., Smith River in northern California, Los Angeles Harbor), but these sites constituted a relatively small percentage of the West Coast coastal area.

Sediment Toxicity

The West Coast region is rated poor for sediment toxicity, with 17% of the coastal area rated poor for this component indicator.

Sediment Contaminants

The West Coast region is rated good for the sediment contaminants component indicator, with 17% of the coastal area rated fair and 3% rated poor for this component indicator. Elevated levels of DDT; chromium, mercury, copper, or other metals; PAHs; or PCBs were primarily responsible for poor ratings at West Coast sampling sites.

Sediment TOC

The West Coast region is rated good for sediment TOC, with 11% of the coastal area rated fair and none of the area rated poor for this component indicator.

Tide pools form along the West Coast's rocky shoreline (courtesy of Brad Ashbaugh).

Benthic Index

Benthic condition in West Coast coastal waters is rated good, with 7% of the coastal area rated fair and 5% rated poor (Figure 6-6). Although several efforts are underway and indices of benthic community condition have been developed for sections of the West Coast (e.g., Smith et al., 2001), there is currently no single benthic community index applicable for the entire West Coast region. In lieu of a West Coast benthic index, the deviation of species richness from an estimate of expected species richness was used as an approximate indicator of benthic condition. This approach requires that species richness be predicted from salinity. A significant linear regression between log species richness and salinity was found for the region, although it was not strong ($R^2 = 0.43$; $p < 0.01$).

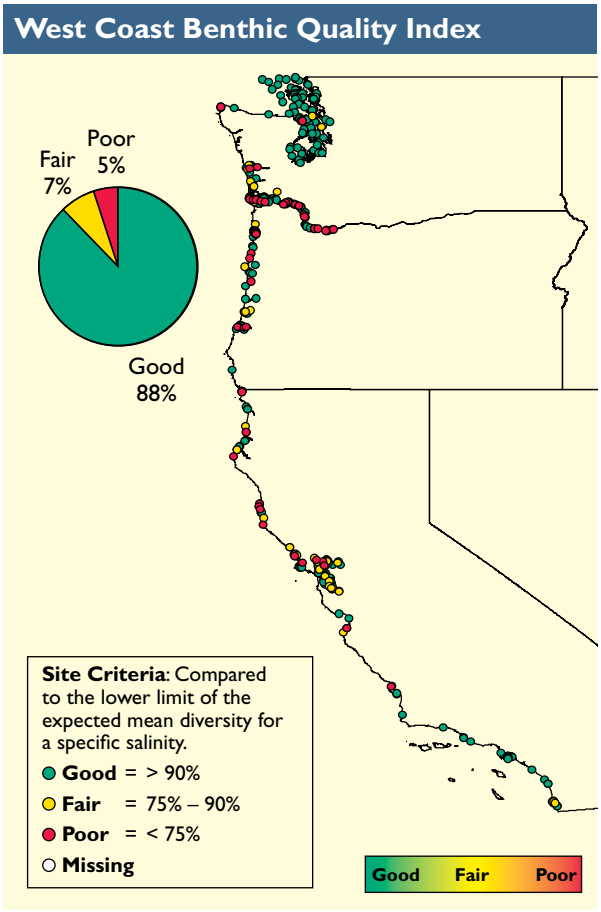


Figure 6-6. Benthic index data for West Coast coastal waters (U.S. EPA/NCA).

Coastal Habitat Index

The coastal habitat index for the coastal waters of the West Coast region is rated poor. From 1990 to 2000, the West Coast experienced a loss of 1,720 acres (0.53%) of the region's wetlands (Dahl, T., FWS, personal communication, 2002). The long-term, average decadal loss rate of West Coast wetlands is 3.4%. Although the number of acres lost for the West Coast region was less than the losses noted in other regions of the United States, the relative percentage of existing wetlands lost in the West Coast region was the highest nationally. West Coast wetlands constitute only 6% of the total coastal wetland acreage in the conterminous 48 states; thus, any loss will have a proportionately greater impact on this regionally limited resource.

Fish Tissue Contaminants Index

The fish tissue contaminants index for the coastal waters of the West Coast region is rated poor. Based on whole-fish contaminant concentrations and EPA Advisory Guidance values, 11% of all stations sampled where fish were caught were rated fair and 26% of stations were rated poor (Figure 6-7). The contaminants found most often in fish tissue samples included total PCBs and DDTs, although elevated mercury levels were occasionally detected.

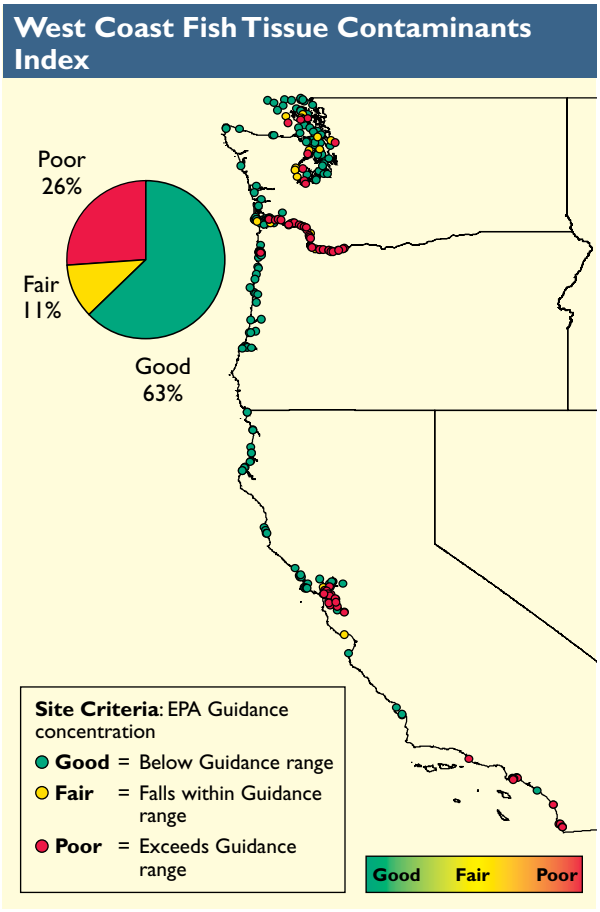


Figure 6-7. Fish tissue contaminants index data for West Coast coastal waters (U.S. EPA/NCA).

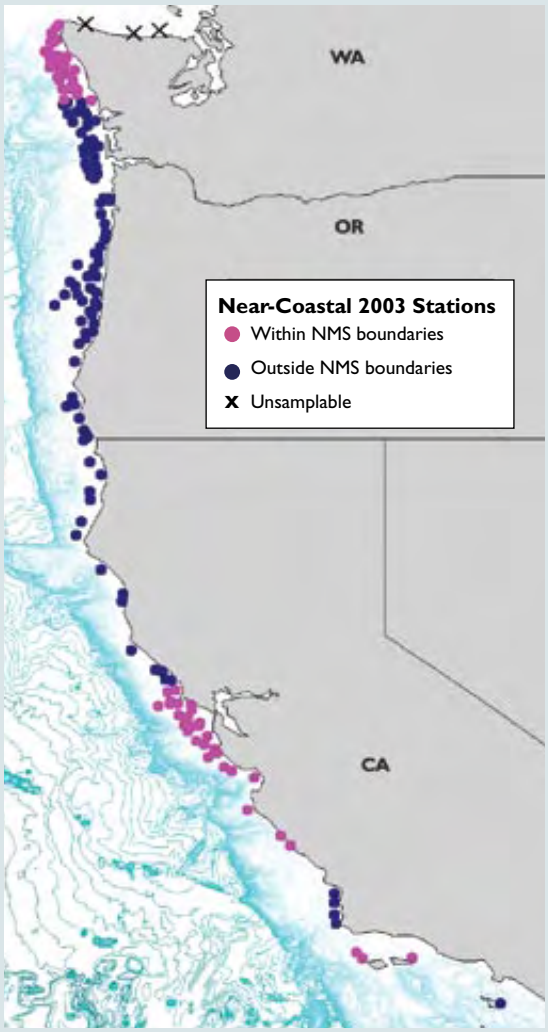
Coastal wetlands provide critical habitat for migratory birds (courtesy of San Francisco Estuary Project).

Highlight

EPA, NOAA, and West Coast States Assess Ecological Condition of Near-Coastal Waters Along the Western U.S. Continental Shelf

An effort is underway by the EPA, NOAA, and West Coast states to assess the condition of aquatic resources in near-coastal waters along the western U.S. continental shelf. The study is based largely on the protocols of EPA's EMAP and thus may be regarded as an extension of previous EMAP efforts in estuaries and inland waters to these offshore areas, where such information has been limited in the past. This near-coastal monitoring effort included EMAP's probabilistic-sampling approach to support statistical estimation of the spatial extent of condition with respect to various measured ecological indicators (U.S. EPA, 2002). Results are intended to serve as a baseline for monitoring potential changes in these indicators over time due to either human or natural factors.

Sampling was conducted successfully in the summer of 2003 at 150 stations (see map) located between the Straits of Juan de Fuca, WA, and Channel Islands, CA, at depths ranging from 100–395 feet (Cooksey et al., 2003). A stratified-random sampling design positioned 50 stations off each West Coast state (Washington, Oregon, and California). In addition, 60 of the 150 stations were located within NOAA NMSs, with 30 of these stations located within the Olympic Coast NMS off the coast of Washington and the remaining 30 stations distributed among the four other West Coast NMSs (Gulf of the Farallones, Cordell Bank, Monterey Bay, and Channel Islands), which are located off the California coast. Thus, the design allows for comparison of condition in NMSs to surrounding, nonsanctuary areas of the shelf (Cooksey et al., 2003).



Western U.S. Continental Shelf sampling sites (NOAA, 2007b).

As in EMAP efforts (including the present NCCR III), multiple indicators were measured synoptically at each station to support the weight of evidence assessments of condition and the examination of associations between biological characteristics and potential environmental controlling factors (U.S. EPA, 2002). Condition was assessed using indicators of (1) habitat condition, (2) general water quality, (3) biological condition with a focus on benthic infauna and demersal fish pathology, and (4) exposure to stressors. The table lists the specific indicators assessed during this study.

The consistent sampling of these variables across such a large number of stations provides a tremendous opportunity for learning more about the spatial patterns of near-coastal resources and the processes controlling their distributions, including potential associations between the presence of stressors and biological responses. For example, a key environmental concern that the program will address with these data is the extent to which pollutants and other materials are being transported out of major rivers, such as the Columbia River, located along the developed areas of the coast. Another concern is how these pollutants may affect biological resources.

The study also demonstrates the benefits of performing science through partnerships that bring together complementary capabilities and resources from a variety of federal, state, and academic institutions. The project is principally funded by the EPA Office of Research and Development. NOAA is also a major partner in the effort, working with EPA to provide overall management and interpretive support, in addition to contributing ship time on the NOAA Ship *McARTHUR II*. NOAA's Northwest Fisheries Science Center also provided field support and analysis of fish pathologies for the June 2003 survey and supplied fish for contaminant analysis from samples collected through the NOAA West Coast Slope Survey fisheries assessment program. State and academic partners include the Washington State Department of Ecology (WDOE), Oregon Department of Environmental Quality, Moss Landing Marine Laboratories, and the Southern California Coastal Water Resources Project (SCCWRP). A separate companion survey led by the SCCWRP was also conducted to assess condition in shelf waters of the SCB using similar methods and indicators. Data from the two surveys will be integrated to provide a comprehensive assessment of ecological condition of near-coastal waters along the majority of the U.S. western continental shelf between the Canadian and Mexican borders. A final report is expected by September 2008. It is anticipated that the resulting information on the condition of ecological resources in these deeper near-coastal waters will make valuable contributions to future reports in the NCCR series.

Environmental Indicators Used in the SAB Study (Cooksey, 2004)
Habitat Condition Indicators
Salinity
Water depth
Dissolved oxygen
pH
Water temperature
Total suspended solids
Transmittance
Sediment grain size
Sediment percent total organic carbon (TOC)
Sediment color/odor
Presence of trash/marine debris
Water Quality Indicators
Chlorophyll *a* concentrations
Nutrient concentrations (nitrates, nitrites, ammonia, phosphate)
Biological Condition Indicators
Benthic species composition
Benthic abundance
Benthic species richness and diversity
External indicators of disease in fish
Presence of nonindigenous species
Exposure Indicators
Chemical contaminants in sediment
Chemical contaminants in fish tissues
Low dissolved oxygen condition
Organic over-enrichment